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(54) INK SET FOR INK-JET RECORDING AND INK-JET RECORDING

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain an ink set causing a discoloration of image hardly recognizable by human visual observation even if a discoloration in ink occurs with time, providing a color image having an apparently improved light resistance by combining plural inks selected so as to make difference in amount of discoloration ratio in the order of lightness of ink.

SOLUTION: This set comprises two or more inks in which the amounts of discoloration ratios of the inks are successively decreased in the order of the ink having high lightness to the ink having low lightness.

Preferably the objective set contains (A) a yellow ink, (B) a magenta ink and (C) a cyanic ink. For example, in a case in which the inks contained in the set comprise the component A, the component B and the component C in the order of higher lightness of the inks, the relation of discoloration ratio of the component A > discoloration ratio of the component B > discoloration ratio of the component C is provided. Pigment-based inks comprising pigments as colorants are preferable as the inks. The discoloration ratio is preferably adjusted by regulating the particle diameter of the pigment.

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CLAIMS

[Claim(s)]

[Claim 1] The ink set with which it is the ink set for ink jet record which consists of two or more ink, and comes to make small magnitude of the rate of fading of said ink at the order of ink to the low high ink of lightness one by one.

[Claim 2] The ink set for ink jet record according to claim 1 ink is yellow ink, Magenta ink, and cyanogen ink, and is [set] yellow ink, Magenta ink, and cyanogen ink sequentially from what has the high lightness of these ink.

[Claim 3] The ink set for ink jet record according to claim 1 ink is yellow ink, Magenta ink, cyanogen ink, and black ink, and is [set] yellow ink, Magenta ink, cyanogen ink, and black ink sequentially from what has the high lightness of these ink.

[Claim 4] The ink set for ink jet record according to claim 1 ink is yellow ink, light Magenta ink, light cyanogen ink, Magenta ink, cyanogen ink, and black ink, and is [set] yellow ink, light Magenta ink, light cyanogen ink, Magenta ink, cyanogen ink, and black ink sequentially from what has the high lightness of these ink.

[Claim 5] The ink set for ink jet record according to claim 1 ink is yellow ink, Orange ink, Magenta ink, cyanogen ink, Green ink, and black ink, and is [set] yellow ink, Orange ink, Magenta ink, cyanogen ink, Green ink, and black ink sequentially from what has the high lightness of these ink.

[Claim 6] The ink set for ink jet record given in any 1 term of claims 1-5 which is the thing in which ink comes to contain a pigment as a coloring agent.

[Claim 7] The ink jet record approach are the ink jet record approach of adhering the drop of ink to discharge and printing by making this drop adhering to a record medium, and using the ink of an ink set given [as ink] in any 1 term of claims 1-6.

[Claim 8] The ink jet record approach according to claim 7 of making said ink adhering on a record medium sequentially from a thing with the large rate of fading.

[Claim 9] The ink jet recording head which comes to arrange the nozzle which makes ink breathe out sequentially from ink with the large rate of fading to the migration direction of a recording head.

[Claim 10] The ink jet recording device which comes to have an ink jet recording head according to claim 9.

[Claim 11] The record medium to which record was performed by the ink jet record approach according to claim 7.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Background of the Invention] Field this invention of invention relates to the ink set for ink jet record which can realize the image excellent in lightfastness, and the ink jet record approach using it.

[0002] When a background technical color picture fades with time, it may change to the image obtained first and a remarkably different image. As one of the approaches for aging of the image by such fading to make it be hard to be recognized, making the rate of fading of each ink comparable is known from the former. It is because it thought that a color picture faded to the same extent as a whole, and fading [of the whole color picture] stopped being able to recognize this easily since each ink fades to the same extent, respectively. On the other hand, generally many properties are demanded of the color material used for the ink for ink jet printers. For example, in order to prevent the regurgitation stability and blinding from an ink jet recording head, the solubility to a solvent and dispersibility are needed. Moreover, not degrading a head member, fixable [to the recording paper], and color enhancement are called for, and safety etc. is required further. In such various constraint, since an usable color material will be limited, it is very difficult to arrange the rate of fading of the ink of each color uniformly further.

[0003]

[Summary of the Invention] Even if this invention person etc. did not arrange uniformly the rate of fading of each ink in the ink for ink jet printers this time, he acquired knowledge that it can make it hard to recognize to fade from on viewing of human being by using the combination of the ink which established and chose the difference as the magnitude of the rate of fading in order of the lightness of ink. Furthermore, this invention person etc. is making ink adhere to a record medium sequentially from a thing with the big rate of fading, and acquired knowledge that the above-mentioned advantage can be enjoyed more effectively. This invention is based on such knowledge.

[0004] And the ink set for ink jet record of this invention is an ink set which consists of two or more ink, and is an ink set with which it comes to make small magnitude of the rate of fading of said ink at the order of ink to the low high ink of lightness one by one. Moreover, the ink jet record approach of this invention is the record approach of adhering the drop of ink to discharge and printing by making this drop adhering to a record medium, and includes using the ink of the ink set of this invention as ink. more desirable voice -- the approach of depending like is an approach of making said ink adhering on a record medium sequentially from a thing with the large rate of fading.

[0005] Even if the color picture formed with the ink set for ink jet record by this invention fades with time amount progress, it cannot recognize the fading easily from on viewing of human being. Therefore, an advantage that the lightfastness of the obtained image can be raised seemingly is acquired. Such an advantage appears notably in the record approach by the ink jet printer which is the record approach of making an ink particle adhering to a record object directly, and appears more notably in the ink system which distributed the department of a face further.

[0006]

[Detailed Description of the Invention] The ink set by ink set this invention comes to combine two or more ink chosen as the order of ink to the low high ink of lightness so that the magnitude of the rate of fading of ink might become small one by one. When it follows, for example, the ink A, B, and C whose lightness is L_a , L_b , and L_c ($L_a > L_b > L_c$), respectively exists, in order to put together and use these for the ink set of this invention, when the rate of fading of those ink is set to F_a , F_b , and F_c , respectively, it is required for the rate of fading to have the relation of $F_a > F_b > F_c$.

[0007] As for the ink set by this invention, it is desirable that it is what contains yellow ink, Magenta ink, and cyanogen ink at least. When the ink contained in this ink set is yellow ink, Magenta ink, and cyanogen ink sequentially from what has the high lightness of ink, the rate of fading of yellow ink (Y), the rate of fading of Magenta ink (M), and the rate of fading of cyanogen ink (C) need to be yellow ink, Magenta ink, and cyanogen ink to descending, the following

relation: $Y > M > C$ of fading, i.e., rate.

[0008] When the ink set by this invention contains black ink further and the lightness of these ink is yellow ink, Magenta ink, cyanogen ink, and black ink sequentially from a high thing, it is required for the rate of fading of black ink (K), the rate of fading of yellow ink (Y), the rate of fading of Magenta ink (M), and the rates of fading of cyanogen ink (C) to be the following relation: $Y > M > C > K$.

[0009] Moreover, when the ink set by this invention contains light Magenta ink and/or light cyanogen ink further in addition to yellow ink, Magenta ink, and cyanogen ink and it is yellow ink, light Magenta ink, light cyanogen ink, Magenta ink, and cyanogen ink sequentially from what has the high lightness of those ink, it is the rate of fading of the yellow ink (Y), It is required for the rate of fading of light Magenta ink (Lm), the rate of fading of light cyanogen ink (Lc), the rate of fading of Magenta ink (M), and the rates of fading of cyanogen ink (C) to be the following relation: $Y > Lm > Lc > M > C$.

[0010] The ink set of this invention is black ink further again. When it contains, the lightness of these ink sequentially from a high thing Yellow ink, In being light Magenta ink, light cyanogen ink, Magenta ink, cyanogen ink, and black ink The rate of fading of black ink (K), and the rate of fading of yellow ink (Y), It is required for the rate of fading of light Magenta ink (Lm), the rate of fading of light cyanogen ink (Lc), the rate of fading of Magenta ink (M), and the rates of fading of cyanogen ink (C) to be the following relation: $Y > Lm > Lc > M > C > K$.

[0011] In addition, the aforementioned "light Magenta" means a thin Magenta, and the aforementioned "light cyanogen" means thin cyanogen. The light Magenta ink used by this invention can be easily prepared by lessening the content of the coloring agent (a pigment or color) used for preparing for example, Magenta ink with a conventional method, or making particle size of a pigment small in the case of pigment ink. The light cyanogen ink used by this invention can also be easily prepared by lessening the content of the coloring agent (a pigment or color) used for preparing for example, cyanogen ink with a conventional method, or making particle size of a pigment small in the case of pigment ink.

[0012] Furthermore, when the ink set by this invention contains Orange ink and/or Green ink further in addition to yellow ink, aforementioned Magenta ink, and aforementioned cyanogen ink and it is yellow ink, Orange ink, Magenta ink, cyanogen ink, and Green ink sequentially from what has the high lightness of these ink, it is the rate of fading of yellow ink (Y) again, It is required for the rate of fading of Orange ink (O), the rate of fading of Magenta ink (M), the rate of fading of cyanogen ink (C), and the rates of fading of Green ink (G) to be the following relation: $Y > O > M > C > G$.

[0013] The ink set of this invention is black ink further again. When it contains and the lightness of these ink is yellow ink, Orange ink, Magenta ink, cyanogen ink, Green ink, and black ink, sequentially from a high thing The rate of fading of black ink (K), It is required for the rate of fading of yellow ink (Y), the rate of fading of Orange ink (O), the rate of fading of Magenta ink (M), the rate of fading of cyanogen ink (C), and the rates of fading of Green ink (G) to be the following relation: $Y > O > M > C > G > K$.

[0014] In this specification, "lightness" means the value of L^* value of the $L^*a^*b^*$ display system specified by CIE.

[0015] Moreover, it sets on these specifications and is a formula (I) as "the rate of fading (F)": $F(\%) = (D_i - D_e) / D_i \times 100$ (I)

It is the value acquired by (D_i is the reflection density measured in early stages of printing among a formula, and D_e is the reflection density measured after the radiationproofing test). It can measure with the usual spectrophotometer of arbitration and, as for the reflection density of ink, a radiationproofing test can also use the usual test method of arbitration. In this invention, the rate of fading of each ink can be adjusted by choosing appropriately the class of coloring agent (a pigment or color) to be used.

[0016] According to the desirable mode of this invention, the use of the pigment system ink which uses a pigment as a coloring agent of ink is desirable. In the case of pigment system ink, the rate of fading of ink can be adjusted by controlling the particle size of the pigment to be used. That is, since the rate of fading of the ink which contains the pigment by making particle size of a pigment small can be raised, the rate of fading can be adjusted by adjusting particle size suitably. In this invention, the particle size of a pigment can express an accumulation pitch diameter as an index. An accumulation pitch diameter is a path in case the accumulation curve becomes 50%, when it asks for the accumulation curve by particle size, having used the whole aggregate product of the target fine particles as 100%. Since it is called the diameter of a core, or the diameter of Media, generally this accumulation pitch diameter is used as mean particle diameter of particle dispersing elements, such as pigment dispersion liquid, in many cases.

[0017] except for the point of the rate of fading of the above as a coloring agent in this invention -- the coloring agent of arbitration, i.e., inorganic dye, and organic dye -- or an inorganic pigment and/or an organic pigment can be used preferably. Use of a pigment is desirable as above-mentioned. In addition to titanium oxide and an iron oxide, as an inorganic pigment, the carbon black manufactured by well-known approaches, such as the contacting method, the

furnace method, or thermal **, can be used. Moreover, as an organic pigment, an azo pigment (an azo lake, insoluble azo pigment, a disazo condensation pigment, or a chelate azo pigment is included), polycyclic type pigments (for example, a phthalocyanine pigment, a BERIREN pigment, very a non pigment, an anthraquinone pigment, a quinacridone pigment, a dioxazine pigment, a thioindigo pigment, an isoindolinone pigment, or a kino FUTARON pigment etc.), color chelates (for example, a basic dye mold chelate, an acid-dye mold chelate, etc.), a nitro pigment, a nitroso pigment, aniline black, etc. can be used.

[0018] According to the especially desirable mode of this invention, the C.I. pigment yellow 74, 109, 110, 138 is used as a yellow pigment, and it is a Magenta pigment, C. I. pigment red 122, 202, and 209 -- using -- as a cyanogen pigment -- C.I. pigment blue 15: -- use C.I. pigment Green 7 and 36 as a Green pigment using 3 and 60, using C.I. pigment Orange 36 and 43 as an Orange pigment, using the C.I. pigment black 7 as a black pigment. In this invention, it is desirable to use a pigment with water compatibility good among these pigments.

[0019] An accumulation pitch diameter is 0.15 micrometers - 0.25 micrometers preferably, and the particle size of a pigment is 0.15 micrometers - 0.2 micrometers more preferably.

[0020] Although this invention is hereafter explained about the case where pigment ink is used, unless it refuses especially in the following publications, those explanation is applied also about color ink.

[0021] In this invention, it is desirable to add in ink the pigment dispersion liquid which were made to distribute a pigment with a dispersant and were obtained. The well-known dispersant used for preparing well-known pigment dispersion liquid conventionally as a desirable dispersant, for example, a macromolecule dispersant, and a surfactant can be used.

[0022] As an example of a giant-molecule dispersant, cellulosics, such as alginic-acid derivative; methyl cellulose, such as a glucosides; alginic acid and propylene glycol alginate, such as natural rubber; Savo Nin, such as protein; gum arabic, such as a naturally-occurring-polymers compound, for example, glue, gelatin, GAZEIN, and albumin, and tragacanth gum, alginic-acid triethanolamine, and ammonium alginate, a carboxymethyl cellulose, hydroxyethyl cellulose, and ethyl hydroxyethyl cellulose, etc. can be mentioned.

[0023] Furthermore, a synthetic high polymer can also be used as a macromolecule dispersant. As a synthetic high polymer **, for example, polyvinyl alcohol; polyvinyl pyrrolidones; Polyacrylic acid, An acrylic-acid-acrylonitrile copolymer, an acrylic-acid potassium-acrylonitrile copolymer, Acrylic resin, such as a vinyl acetate-acrylic ester copolymer and an acrylic-acid-acrylic-acid alkyl ester copolymer; A styrene-acrylic-acid copolymer, A styrene-methacrylic-acid copolymer, a styrene-methacrylic-acid acrylic-acid alkyl ester copolymer, A styrene-alpha-methylstyrene-acrylic-acid copolymer, styrene-acrylic-acid-resin [, such as a styrene-alpha-methylstyrene-acrylic-acid-acrylic-acid alkyl ester copolymer,]; -- styrene-maleic-acid; -- styrene-maleic-anhydride; -- vinyl naphthalene-acrylic-acid copolymer; -- vinyl naphthalene-maleic-acid copolymer; -- Vinyl acetate system copolymers and these salts, such as a vinyl acetate-ethylene copolymer, a vinyl acetate-fatty-acid vinyl ethylene copolymer, a vinyl acetate maleate copolymer, a vinyl acetate crotonic-acid copolymer, and a vinyl acetate acrylic-acid copolymer, can be mentioned. In these, the copolymer of a monomer with especially a hydrophobic radical and a monomer with a hydrophilic radical and the polymer which consists of a monomer having a hydrophobic radical and a hydrophilic radical are desirable.

[0024] As the above-mentioned salt, a salt with diethylamine, ammonia, ethylamine, triethylamine, propylamine, isopropylamine, a dipropyl amine, a butylamine, an isobutyl amine, triethanolamine, diethanolamine, aminomethyl propanol, a morpholine, etc. can be mentioned. the weight average molecular weight of these copolymers -- desirable -- 3,000-30,000 -- it is 5,000-15,000 more preferably.

[0025] Moreover, it is an example of a surfactant desirable as a dispersant, Fatty-acid salts, a high-class alkyl dicarboxylic acid salt, higher-alcohol sulfate salts, The condensate of a high-class alkyl sulfonate, a higher fatty acid, and amino acid, a sulfo succinate salt, Anionic surfactants, such as naphthenate, liquid fatty-oil sulfate salts, and alkyl allyl compound sulfonates; A fatty-acid amine salt, Cationic surfactants, such as quaternary ammonium salt, sulfonium salt, and phosphonium salt; Polyoxyethylene alkyl ether Nonionic surfactants, such as polyoxyethylene alkyl ester, sorbitan alkyl ester, and polyoxyethylene sorbitan alkyl ester, etc. can be mentioned. the addition of these dispersants -- the pigment 1 weight section -- receiving -- desirable -- the range of 0.06 - 3 weight section -- it is the range of 0.125 - 3 weight section more preferably.

[0026] Moreover, as for the ink used by this invention, according to the desirable mode of this invention, it is desirable to come to contain a wetting agent further. As the desirable example of a wetting agent What **, a diethylene glycol, a polyethylene glycol, a polypropylene glycol, ethylene glycol, propylene glycol, a butylene glycol, triethylene glycol, 1 and 2, 6-hexane triol, a thioglycol, hexylene glycol, a glycerol, trimethylolethane, trimethylol propane, a urea, 2-pyrrolidone, a N-methyl-2-pyrrolidone, 1,3-dimethyl-2-imidazolidinone, etc. are mentioned, and has especially an ethyleneoxide radical is desirable, and a diethylene glycol is the most desirable.

[0027] Furthermore, it is desirable to add a low-boiling point organic solvent further in addition to these wetting agents. As a desirable example of a low-boiling point organic solvent, a methanol, ethanol, n-propanol, iso-propanol, n-butanol, a sec-butanol, a tert-butanol, an iso-butanol, n-pentanol, ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, the diethylene-glycol monomethyl ether, diethylene glycol monoethyl ether, the triethylene glycol monomethyl ether, the triethylene glycol monoethyl ether, etc. are mentioned. Especially monohydric alcohol is desirable. the addition of these wetting agents -- ink -- 2 - 20% of the weight of the range is preferably suitable 0.5 to 40% of the weight. moreover, the addition of a low-boiling point organic solvent -- ink -- 1.5 - 6% of the weight of the range is preferably suitable 0.5 to 10% of the weight.

[0028] According to the desirable mode of this invention, the ink used by this invention can contain a surfactant. As an example of a desirable surface active agent, they are anionic surface active agents (for example, sodium dodecylbenzenesulfonate, lauryl acid sodium, ammonium salt of polyoxyethylene-alkyl-ether sulfate, etc.), Nonionic surfactants (for example, polyoxyethylene alkyl ether, polyoxyethylene alkyl ester, polyoxyethylene sorbitan fatty acid ester, polyoxyethylene alkyl phenyl ether, polyoxyethylene alkylamine, polyoxyethylene alkylamide, etc.) can be mentioned, independent or two sorts or more can be mixed, and these can be used. Moreover, it is also possible to use SAFI Norians 82, 104, 440, 465, and 485 and TG(for all to be products made from Air Products and Chemicals Inc.)) for the acetylene glycol [olefin Y and a list.

[0029] The ink used by this invention can contain sugar. As an example of a saccharide, monosaccharide, disaccharide, oligosaccharide (trisaccharide and tetrasaccharide are included), and polysaccharide can be mentioned, and a glucose, a mannose, a fructose, a ribose, a xylose, arabinose, a galactose, aldonic acid, a glucitol, sorbitol, a maltose, a cellobiose, a lactose, a sucrose, trehalose, or a maltotriose can be mentioned preferably. An alginic acid, alpha-cyclodextrin, a cellulose, etc. are contained in the aforementioned polysaccharide. Moreover, as a derivative of these saccharides, the reducing sugar of the above mentioned saccharide, for example, sugar-alcohol, oxidization sugar, amino acid (for example, aldonic acid, uronic acid, etc.), thiosugar, etc. can be mentioned. Especially sugar-alcohol is desirable and can mention maltitol, sorbitol, etc. as the example. About 0.1 - 40% of the weight of the ink of the content of these saccharides is desirable, and it is 0.5 - 30% of the weight of the range more preferably.

[0030] The ink used by this invention can contain a resin emulsion. A continuous phase is water and a resin emulsion means the emulsion whose dispersed phases are the following resinous principles. As a resinous principle of a dispersed phase, acrylic resin, vinyl acetate system resin, styrene-butadiene system resin, vinyl chloride system resin, acrylic-styrene resin, butadiene system resin, styrene resin, etc. are mentioned. As for this resin, according to the desirable mode of this invention, it is desirable that it is a polymer having a hydrophilic part and a hydrophobic part. Moreover, although it is not limited especially as long as the particle diameter of these resinous principles forms an emulsion, about 150nm or less is desirable, and is about 5-100nm more preferably.

[0031] These resin emulsions can be obtained by mixing a resin particle in water with a surfactant by the case. For example, the emulsion of acrylic resin or styrene-acrylic resin can be obtained by mixing an acrylic acid (meta) and a surfactant with acrylic ester (meta), or styrene and acrylic ester (meta) in water by the case. As for the rate of mixing with a resinous principle and a surfactant, it is desirable to usually carry out to 10:1 to about 5:1. When the amount of the surface active agent used does not fulfill said range, an emulsion is difficult to get, and when crossing said range, since the water resisting property of ink falls or there is an inclination for permeability to get worse, it is not desirable.

[0032] Especially a surfactant is a desirable example, although not limited, anion system surface active agents (for example, dodecyl BENZAN sulfonic-acid sodium, Raul Lil acid sodium, ammonium salt of polyoxyethylene-alkyl-ether sulfate, etc.) and the Nonion system surface active agents (for example, polyoxyethylene alkyl ether, polyoxyethylene alkyl ester, polyoxyethylene sorbitan fatty acid ester, polyoxyethylene alkyl phenyl ether, polyoxyethylene alkylamine, polyoxyethylene alkylamide, etc.) are mentioned, and independent in these -- or two or more sorts can be mixed and it can use. moreover, the rate of the resin as a dispersed phase component, and water -- the resin 100 weight section -- receiving -- water 60 - the 400 weight sections -- the range of the 100 - 200 weight section is preferably suitable.

[0033] It is also possible to use a well-known resin emulsion as such a resin emulsion, for example, the resin emulsion of a publication can be used for JP,62-1426,B, JP,3-56573,A, JP,3-79678,A, JP,3-160068,A, and JP,4-18462,A each official report etc. as it is.

[0034] moreover, the thing using a commercial resin emulsion -- possible -- for example The micro gel E-1002, E-5002 (a styrene-acrylic resin emulsion, Nippon Paint Co., Ltd. make), BONKOTO 4001 (an acrylic resin emulsion, Dainippon Ink & Chemicals, Inc. make), BONKOTO 5454 (a styrene-acrylic resin emulsion, Dainippon Ink & Chemicals, Inc. make), SAE1014 (a styrene-acrylic resin emulsion, Nippon Zeon Co., Ltd. make), SAIBI Norian SK-200 (an acrylic resin emulsion, SAIDEN CHEMICAL INDUSTRY CO., LTD. make), etc. are mentioned.

[0035] In addition to this, the ink used by this invention also becomes unable to include pH regulator, antiseptics, an antifungal agent, etc. if needed.

[0036] The ink used by this invention can manufacture said component by distributing and mixing by the suitable approach. After mixing by suitable dispersers (for example, a ball mill, a sand mill, attritor, a roll mill, an agitator mill, a Henschel mixer, a colloid mill, an ultrasonic homogenizer, a jet mill, on-GUMIRU, etc.) and using an organic solvent and mixture except a volatile component as a homogeneous constituent preferably, it is desirable to add an organic solvent and a volatile component. Then, in order to remove the big and rough particle and foreign matter leading to blinding, it is desirable to give filtration (reduced pressure or pressure filtration using the metal filter, the membrane filter, etc. preferably) or centrifugal separation. [0037] In the ink jet record approach by ink jet record approach this invention, the ink of the ink set of this invention is used as ink. In the ink jet record approach by this invention, it is desirable to make ink adhere on a record medium sequentially from a thing with the large rate of fading.

[0038] For example, when enforcing the ink jet record approach by this invention using yellow ink, Magenta ink, and cyanogen ink at least, it is, Sequentially from what has the high lightness of ink, when it is yellow ink, Magenta ink, and cyanogen ink, the combination of the ink in which the relation to $Y > M > C$ of the rate of fading of yellow ink (Y), the rate of fading of Magenta ink (M), and the rate of fading of cyanogen ink (C) becomes is chosen, and it is desirable first discharge and to carry out [yellow ink] the regurgitation of the cyanogen ink for Magenta ink discharge and after them continuously.

[0039] In the ink jet record approach by this invention Moreover, for example, the aforementioned yellow ink, It adds to Magenta ink and/or cyanogen ink. Further Light Magenta ink, In using more than combining one sort or it of light cyanogen ink and/or black ink Sequentially from what has the high lightness of those ink, when it is yellow ink, light Magenta ink, light cyanogen ink, Magenta ink, cyanogen ink, and black ink, it is the rate of fading of yellow ink (Y), It is desirable that choose the combination of ink so that the relation to $Y > Lm > Lc > M > C > K$ of the rate of fading of light Magenta ink (Lm), the rate of fading of light cyanogen ink (Lc), the rate of fading of Magenta ink (M), the rate of fading of cyanogen ink (C), and the rate of fading of black ink (K) may become, and the rate of fading of those ink carries out the regurgitation to descending on a record medium.

[0040] Moreover, when using in the ink jet record approach by this invention more than combining one sort or it of Orange ink, Green ink, and/or black ink further in addition to yellow ink, aforementioned Magenta ink, and/or aforementioned cyanogen ink, it is yellow ink, Orange ink, Magenta ink, cyanogen ink, Green ink, and black ink sequentially from what has the high lightness of those ink, and it is the rate of fading of yellow ink (Y), It is desirable that choose the combination of ink so that the relation to $Y > O > M > C > G > K$ of the rate of fading of Orange ink (O), the rate of fading of Magenta ink (M), the rate of fading of cyanogen ink (C), the rate of fading of Green ink (G), and the rate of fading of black ink (K) may become, and the rate of fading of those ink carries out the regurgitation to descending on a record medium.

[0041] Although each ink's fading advances based on the aforementioned relational expression with time, since it is substantially impossible to recognize the difference in the rate of fading or it is difficult from viewing in the image obtained by the aforementioned this invention approach, it can make it hard to recognize from viewing as a result to fade [of the whole color picture]. That is, according to the approach of this invention, the lightfastness of the obtained image can be raised seemingly.

[0042] This invention offers the ink jet recording head which comes to arrange the nozzle which makes ink breathe out sequentially from ink with the large rate of fading to the migration direction of a recording head again. Furthermore, this invention also offers the ink jet recording device which comes to have said ink jet recording head. According to this invention, the record medium to which record was performed by said ink jet record approach is also offered.

[0043]

[Example] Hereafter, although an example explains this invention concretely, these do not limit the range of this invention. The ink which consists of the following combination components was prepared, and it considered as the color ink set.

[0044] In the amount which shows three sorts of pigments below preparation (a) of the color ink set 1 below, the solvent object mentioned later was distributed and the color ink set 1 was prepared.

Pigment for cyanogen ink C.I. pigment blue 15:3 2 % of the weight Pigment for Magenta ink C.I. pigment red 122 3 % of the weight Pigment for yellow ink C.I. pigment yellow 74 The presentation of the solvent object used for preparation of 2 % of the weight (b) each ink is shown below.

[0045]

Styrene-acrylic-acid copolymer (dispersant) 0.5 % of the weight Sucrose 0.7 % of the weight Maltitol 6.3 % of the weight Ethylene glycol 15 % of the weight Triethylene glycol monobutyl ether 5 % of the weight

Ethylenediaminetetraacetic acid disodium (chelating agent) 0.01 % of the weight Antiseptics (product made from Proxel-XLII;ICI) 0.3 % of the weight Pure water Residue [0046] The black ink 1 of the presentation below preparation of black ink 1 was prepared.

Carbon black MA 7 (Mitsubishi Kasei Corp. make) 5 % of the weight Styrene-acrylic-acid copolymer (dispersant) 1 % of the weight Sucrose 0.7 % of the weight Maltitol 6.3 % of the weight Glycerol 10 % of the weight 2-pyrrolidone 2 % of the weight SAFI Norian 465 0.5 % of the weight Potassium hydroxide 0.1 % of the weight

Ethylenediaminetetraacetic acid disodium (chelating agent) 0.01 % of the weight Antiseptics (product made from Proxel-XLII;ICI) 0.3 % of the weight Pure water Residue [0047] In the amount which shows two sorts of pigments below preparation (a) of the color ink set 2 below, the solvent object mentioned later was distributed and the color ink set 2 was prepared.

Pigment for light cyanogen ink C.I. pigment blue 60 0.3 % of the weight Pigment for light Magenta ink C.I. pigment red 209 0.4 % of the weight [0048] (b) The presentation of the solvent object used for preparation of each ink is shown below.

Styrene-acrylic-acid copolymer (dispersant) 0.5 % of the weight Sucrose 0.7 % of the weight Maltitol 6.3 % of the weight Ethylene glycol 15 % of the weight Glycerol 10 % of the weight SAFI Norian 465 1 % of the weight Triethylene glycol monobutyl ether 3 % of the weight Ethylenediaminetetraacetic acid disodium (chelating agent) 0.01 % of the weight Antiseptics (product made from Proxel-XLII;ICI) 0.3 % of the weight Pure water Residue [0049] In the amount which shows two sorts of pigments below preparation (a) of the color ink set 3 below, the solvent object mentioned later was distributed and the color ink set 3 was prepared.

Pigment for Green ink C.I. pigment blue 72 2 % of the weight Pigment for Orange ink C.I. pigment Orange 43 3 % of the weight [0050] (b) The presentation of the solvent object used for preparation of each ink is shown below.

Styrene-acrylic-acid copolymer (dispersant) 0.5 % of the weight Sucrose 0.7 % of the weight Maltitol 6.3 % of the weight Ethylene glycol 15 % of the weight SAFI Norian 465 1 % of the weight Triethylene glycol monobutyl ether 3 % of the weight Ethylenediaminetetraacetic acid disodium (chelating agent) 0.01 % of the weight Antiseptics (product made from Proxel-XLII;ICI) 0.3 % of the weight Pure water Residue [0051] In the amount which shows three sorts of pigments below preparation (a) of the color ink set 4 below, the solvent object mentioned later was distributed and the color ink set 4 was prepared.

Pigment for cyanogen ink C.I. pigment blue 15:3 2 % of the weight Pigment for Magenta ink C.I. pigment red 57:1 3 % of the weight Pigment for yellow ink C.I. pigment yellow 110 2 % of the weight [0052] (b) The presentation of the solvent object used for preparation of each ink is shown below.

Styrene-acrylic-acid copolymer (dispersant) 0.5 % of the weight Sucrose 0.7 % of the weight Maltitol 6.3 % of the weight Ethylene glycol 15 % of the weight Triethylene glycol monobutyl ether 5 % of the weight Ethylenediaminetetraacetic acid disodium (chelating agent) 0.01 % of the weight Antiseptics (product made from Proxel-XLII;ICI) 0.3 % of the weight Pure water Residue [0053] The ink of the predetermined accumulation pitch diameter shown in the example and the example of a comparison which are mentioned later was obtained by inserting in a roll mill each ink prepared with adjustment and the measurement above of an accumulation pitch diameter, and filtering the coarse-grained fraction which has the particle size more than fixed by controlling distributed time amount. In addition, the accumulation pitch diameter was measured with the particle-size-distribution measuring device (micro truck 9230 UPA; RIZUNOSU lap company make) of a laser dispersion type.

[0054] Measurement of the rate of fading in the example and the example of a comparison below the rate measurement of fading was carried out by the radiationproofing test using xenon weatherometer Ci35A (ATLAS). 300 kJ/m² (about 238 hours) was exposed under the conditions of the black panel temperature of 63 degrees C, 50% of relative humidity, and 340nm ultraviolet radiation irradiance 0.35 W/m². Measurement of reflection density is Spectrophotometer GRETAG. Using SPM50 (GRETAG), it is the light source D50, is conditions without a light source filter, and is white standard absolute white, reflection density is measured with the angle of visibility of 2 degrees, and it is said formula (I). : $F(\%) = (D_i - D_e) / D_i \times 100$ (I)

The rate of fading was calculated by (the inside of a formula, and F, D_i and D_e are the same semantics as the above). [0055] Measurement of lightness measurement lightness was similarly performed using the same equipment as measurement of the above-mentioned reflection density.

[0056] The color ink set 1 which consists of ink containing the pigment of the following accumulation pitch diameter was printed using example 1 ink-jet-printer MJ-510C (cyanogen, a Magenta, and the printer that uses the ink of three colors of yellow: Seiko Epson, Inc. make) to the print media only for ink jets (the Seiko Epson make, exclusive gloss film).

[0057] Accumulation pitch diameter: Cyanogen pigment: 105-micrometer Magenta pigment: 65-micrometer yellow

pigment: The relation of the rate of fading of 53-micrometer yellow ink (Y), the rate of fading of Magenta ink (M), and the rate of fading of cyanogen ink (C) was $Y > M > C$.

[0058] Moreover, the lightness of each ink was as ***** follows.

lightness: -- Y: 88M : 52C: 46 printing -- descending of the rate of fading of ink, i.e., the beginning, -- yellow ink -- it carried out so that it might adhere to Magenta ink and the last in order of cyanogen ink continuously.

[0059] The sequence of example 2 printing was first printed by the same actuation as said example 1 except cyanogen ink and carrying out so that it may adhere to Magenta ink and the last in order of yellow ink continuously.

[0060] The color ink set 1 and the black ink 1 of the following accumulation pitch diameter were printed using example 3 ink-jet-printer MJ-930C (cyanogen, a Magenta, yellow, and the printer that uses the ink of four colors of black: Seiko Epson, Inc. make) to the print media only for ink jets (the Seiko Epson make, exclusive gloss film).

[0061] Accumulation pitch diameter: Black pigment: 95-micrometer cyanogen pigment: 105-micrometer Magenta pigment: 65-micrometer yellow pigment: The relation of the rate of fading of 53-micrometer yellow ink (Y), the rate of fading of Magenta ink (M), the rate of fading of cyanogen ink (C), and the rate of fading of black ink (K) was $Y > M > C > K$.

[0062] Moreover, the lightness of each ink was as ***** follows.

lightness: -- Y: 88M : 52C: 46K : 16 printing -- descending of the rate of fading of ink, i.e., the beginning, -- yellow ink -- continuing -- Magenta ink -- it carried out so that it might adhere to cyanogen ink and the last in order of black ink continuously.

[0063] The color ink set 1, black ink 1, and the color ink set 2 were printed using example 4 ink-jet-printer PM-700C (the printer which uses the ink of cyanogen, a Magenta, yellow, black, light cyanogen, and six colors of a light Magenta: Seiko Epson, Inc. make) to the print media only for ink jets (the Seiko Epson make, exclusive gloss film).

[0064] Accumulation pitch diameter: Black pigment: 95-micrometer cyanogen pigment: 105-micrometer Magenta pigment: 65-micrometer yellow pigment: 53-micrometer light cyanogen pigment: 105-micrometer light Magenta pigment: Rate of fading of 65-micrometer yellow ink (Y), The relation of the rate of fading of light Magenta ink (Lm), the rate of fading of light cyanogen ink (Lc), the rate of fading of Magenta ink (M), the rate of fading of cyanogen ink (C), and the rate of fading of black ink (K) was $Y > Lm > Lc > M > C > K$.

[0065] Moreover, the lightness of each ink was as ***** follows.

lightness: -- Y52C : 46K : 16 printing -- descending of the rate of fading of ink, i.e., the beginning, -- yellow ink -- continuing -- light Magenta ink -- continuing -- light cyanogen ink -- continuing -- Magenta ink -- it carried out so that it might adhere to cyanogen ink and the last in order of black ink continuously. : 88Lm : 68Lc : 63M :

[0066] The color ink set 1, black ink 1, and the color ink set 3 were printed using example 5 ink-jet-printer PM-700C to the print media only for ink jets (the Seiko Epson make, exclusive gloss film).

[0067] Accumulation pitch diameter: Black pigment: 95-micrometer cyanogen pigment: 105-micrometer Magenta pigment: 65-micrometer yellow pigment: 53 micrometer Green pigment: 100-micrometer Orange pigment: Rate of fading of 88-micrometer yellow ink (Y), The relation of the rate of fading of Orange ink (O), the rate of fading of Magenta ink (M), the rate of fading of cyanogen ink (C), the rate of fading of Green ink (G), and the rate of fading of black ink (K) was $Y > O > M > C > G > K$.

[0068] Moreover, the lightness of each ink was as ***** follows.

lightness: -- Y 16 printing -- descending of the rate of fading of ink, i.e., the beginning, -- yellow ink -- continuing -- Orange ink -- continuing -- Magenta ink -- continuing -- cyanogen ink -- it carried out so that it might adhere to Green ink and the last in order of black ink continuously. : 88O: 65M : 52C: 46G : 44K :

[0069] The color ink set 1 of the following accumulation pitch diameter was printed using example 6 ink-jet-printer MJ-510C to the print media only for ink jets (the Seiko Epson make, exclusive gloss film).

[0070] Accumulation pitch diameter: Cyanogen pigment: 30 micrometer Magenta pigment: 110-micrometer yellow pigment: The relation of the rate of fading of 53-micrometer yellow ink (Y), the rate of fading of cyanogen ink (C), and the rate of fading of Magenta ink (M) is large in order of $Y > C > M$.

[0071] Moreover, the lightness of each ink was as ***** follows.

lightness: -- Y: 88C: 55M : 42 -- again -- printing -- descending of the rate of fading of ink, i.e., the beginning, -- yellow ink -- it carried out so that it might adhere to cyanogen ink and the last in order of Magenta ink continuously.

[0072] The color ink set 4 and the black ink 1 of the following accumulation pitch diameter were printed using ink jet printer MJ-930C to the print media only for ink jets (the Seiko Epson make, exclusive gloss film) like 2 one example of a comparison.

[0073] Accumulation pitch diameter: Black pigment: 95-micrometer cyanogen pigment: 105-micrometer Magenta pigment: 51 micrometer yellow pigment: The relation of the rate of fading of 115-micrometer Magenta ink (M), the

rate of fading of yellow ink (Y), the rate of fading of cyanogen ink (C), and the rate of fading of black ink (K) was large in order of $M > Y > C > K$.

[0074] Moreover, the lightness of each ink was as ***** follows.

lightness: -- M: 70Y: 68C: 46K : order with 16 printing low [the rate of fading of ink], i.e., the beginning, -- black ink -- continuing -- cyanogen ink -- it carried out so that it might adhere to yellow ink and the last in order of Magenta ink continuously.

[0075] The portrait image was printed in the examples 1-6 of light-fast evaluation, and the example 1 of a comparison, and it was left for one month to the outdoors, and was exposed to direct rays. It judged by showing the existence of degradation of the portrait image as 50 in a broad age group. A judgment is performed in the following four steps (A-D), and the result is shown in Table 1.

A: A judgment that it deteriorated is less than (superior level) ten persons.

B: A judgment that it deteriorated is ten or more persons [less than (practical use level) 25].

C: A judgment that it deteriorated is 25 or more persons [less than (tolerance) 40].

D: A judgment that it deteriorated is 40 or more (a defect's level) persons.

[0076]

表 1

	画像劣化
例 1	A
例 2	B
例 3	A
例 4	A
例 5	A
例 6	B
比較例 1	D

[Translation done.]